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NORTHWESTERN UNIVERSITY

Courses in Chemistry

Practical Training for
Analytical, Sanitary,
Pharmaceutical, Commercial,
Manufacturing, Engineering
and Mining Chemists



NORTHWESTERN UNIVERSITY BUILDING
Cor. Lake and Dearborn Streets : : : CHICAGO

FACULTY.

EDMUND JANES JAMES, PH. D., LL. D., *President of the University.*

OSCAR OLDBERG, PHARM. D., *Dean of the School of Pharmacy.*

Inorganic and Analytical Chemistry—

PROFESSOR THEODORE WHITTELSEY, PH. D. (University of Goettingen), *Director of Inorganic Chemical Laboratories.*

MR. DAVID CHARLES ECCLES, SC. B., A. M. (Columbia University).

MR. GUSTAVE E. F. LUNDELL, SC. B. (Cornell University).

MR. LEONARD A. JOHNSON, PH. C. (Northwestern University).

Mineralogy, Blowpipe Analysis and Mineral Assaying—

PROFESSOR ALJA ROBINSON CROOK, PH. D. (University of Munich).
Director of the Laboratories for Mineralogy and Ore Assaying.

Organic Chemistry—

PROFESSOR HARRY MANN GORDIN, PH. D. (University of Berne),
Director of the Organic Chemical Laboratory.

ASSISTANT PROFESSOR CHARLES W. PATTERSON, SC. B., PH. C.
(Northwestern University).

Botany, Microscopy, Pharmacognosy and Bacteriology—

PROFESSOR RAYMOND H. POND, PH. D. (University of Michigan),
Director of the Laboratories for Botany, Microscopy and Bacteriology.

MR. GERHARD H. JENSEN, SC. B. (Cornell University).

Manufacturing and Pharmacy—

PROFESSOR OSCAR OLDBERG, PHARM. D. (*honoris causa*).
Director of the Manufacturing and Dispensing Laboratories.

ASSISTANT PROFESSOR MAURICE A. MINER, PHARM. M. (University of Michigan).

MR. DAVID CHARLES ECCLES, SC. B., A. M. (Columbia University).

MR. JOHN FERDINAND FISCHNER, PH. C. (Northwestern University).

Physiology and Materia Medica—

ASSISTANT PROFESSOR HARRY KAHN, PHARM. M. (University of Michigan), M. D. (Northwestern University).

NORTHWESTERN UNIVERSITY

COURSES IN CHEMISTRY

NORTHWESTERN UNIVERSITY BUILDING

87 LAKE STREET

CHICAGO

In response to numerous requests Northwestern University has decided to offer the facilities of University Building at the corner of Lake and Dearborn streets, Chicago, to students who wish to prepare themselves for the occupation of general, sanitary and commercial analytical chemists and microscopists and for work in chemical and pharmaceutical manufacturing laboratories. The program of work arranged for this purpose is designed to prepare the student for the duties to be performed by chemists and microscopists under the food and drug laws, as well as for other work usually performed by public analysts or commercial chemists, and it includes also mineralogy and mineral assaying. It is believed that the rapid growth of the chemical industries of the country and the adoption of national and state pure food and drug laws will largely increase the demand for such workers.

The instruction will be given in the laboratories of the University's School of Pharmacy, which occupies the entire fourth floor of the University Building. A program of work has been arranged extending through four terms of eighteen weeks each. Lectures will be given on inorganic, organic and analytical chemistry and in mineralogy, botany and microscopy, together with laboratory training in general inorganic and organic chemistry, qualitative and quantitative analysis. Special courses will be given in the analysis of iron ores, iron and steel, slags and cement, the "wet assay" of ores of copper, lead and zinc and the "fire assay" of ores of gold and silver; the examination of water, milk, butter, cheese, beverages, drugs, oils, fats, soaps, etc.; in commercial microscopy as applied to drugs, spices, foodstuffs, textiles and other commodities, and in the manufacture of pure chemical and pharmaceutical preparations from the raw materials.

The laboratory work in this programme amounts to about 1,700 hours, extending through two years.

Certificates in due form will be given upon satisfactory completion of these courses. Students who have in addition completed two full years of college work in the arts and sciences exclusive of chemistry may receive the degree of Bachelor of Science.

NORTHWESTERN UNIVERSITY BUILDING.

In 1902 the University purchased the seven-story building at the southeast corner of Lake and Dearborn streets and completely remodeled it for the use of its Schools of Law, Pharmacy and Dentistry. The building is 160 by 180 feet and is provided with steam heat, electric lights and electric elevators. The School of Pharmacy occupies the entire fourth floor of this building, together with an additional laboratory on the first floor. An adequate conception of the ample facilities thus provided may be formed from the fact that the laboratories afford convenient desk room for 300 students, working at one time, each at his own individual desk.

The location of the building assures to students in fullest measure the educational opportunities which residence in a large city affords. The building is at the edge of the wholesale district of the city and the business houses dealing in the most various products of the chemical industries are represented in the immediate neighborhood. Its easy access to all the means of transportation, extending into the manufacturing and industrial districts of Chicago, bring these also within reach of the students.

Three of the splendid public libraries of Chicago are in the immediate neighborhood of the building. Of these the John Crerar Library, which is the scientific library of the city and is unusually complete in chemical literature, is within five minutes walk. Chicago is one of the greatest centers of commerce, manufacture, education, art and every form of useful human activity, and life in it, under the safeguards which university membership provides, may be made a potent factor in the development of character and strength.

LABORATORIES.

The laboratory instruction will be given in the following laboratories:

1. Laboratory of Inorganic Chemistry, for the introductory courses in inorganic and analytical chemistry, with a

floor space of 1,536 square feet.

2. Laboratory for Quantitative Analysis, with a floor space of 1,428 square feet.

3. Laboratory of Organic Chemistry, for the courses in organic chemistry and the analysis of drugs, foods and water, with a floor space of 1,846 square feet.

4. Laboratory for Microscopy and Pharmacography, for the microscopical study and examination of plants, drugs and foodstuffs, with a floor space of 1,224 square feet.

5. The Manufacturing Laboratory, for practice in the production of chemicals and pharmaceutical preparations, with a floor space of 2,289 square feet.

6. The Laboratory for Ore Assaying is in Fayerweather Hall of Science at Evanston.

7. The Bacteriological Laboratory, with a floor space of 864 square feet.

8. The Dispensing Laboratory, with a floor space of 1,507 square feet.

These laboratories are thoroughly equipped with desks, water, gas, furnaces, balances and microscopes and other fixtures and apparatus needed in the various courses.

THE LIBRARY.

The library of the School of Pharmacy, in addition to its very complete equipment in pharmaceutical journals, both the bound volumes of the previous years and the periodicals currently received, contains the following specifically chemical journals:

Berichte der deutschen chemischen Gessellschaft.

Chemisches Centralblatt.

Journal of the American Chemical Society.

Journal of the Chemical Society (London).

Zeitschrift für analytische Chemie.

Zeitschrift für anorganische Chemie.

A well selected library of standard text-books, dictionaries, monographs and other reference books on pure chemistry and on analytical and industrial chemistry.

This library is open to all students at specified hours and the current journals are accessible to them at all times.

BRIEF DESCRIPTION *of* COURSES

for the

TRAINING OF ANALYTICAL CHEMISTS AND MICROSCOPISTS

offered by Northwestern University at University Building,
corner of Lake and Dearborn streets, Chicago.

INORGANIC AND ANALYTICAL CHEMISTRY.

1.—*General Inorganic Chemistry*.—An introductory course in which the student lays the foundation necessary for successful work in the other courses in chemistry and in the courses in pharmacy. The elementary principles of the science are developed in connection with the consideration of oxygen, hydrogen, nitrogen and the other especially important non-metallic elements. This is followed by a systematic study of all the common chemical elements and their compounds.

Lectures, illustrated by experiments, three hours weekly.—*Professor Whittelsey*. Recitations, two hours weekly in sections as assigned.—*Professor Whittelsey and Mr. Eccles*.

This course extends through eighteen weeks and is accompanied in the laboratory by courses 2 and 3A.

2.—*General Inorganic Chemistry, Laboratory Work*.—This course, together with the lectures and recitations described in course 3A and course 1, form an integral course, the discussion of the theories of the science in the lecture room being based in large part on the experiments performed in the laboratory. There the student prepares the more important elements and their compounds and observes the physical and chemical properties of each. Since a perfunctory performance of the laboratory work is regarded as but little more than valueless, emphasis is laid on the logical and discriminating interpretation of the results of the experiments.

About twenty-seven laboratory periods of three hours each extending through about nine weeks.—*Professor Whittelsey and Mr. Lundell; Mr. Johnson*.

3A.—*Qualitative Analysis (Known Substances)*.—Study in the laboratory and class room of the methods of separation and identification of the principal bases and acids, together with the reactions involved.

In this course the practical requirements of the pharmacist and chemist in the intelligent application of the identity and purity tests of the Pharmacopœia are kept in view.

About twenty-seven laboratory periods of three hours each.—*Professor Whittelsey and Mr. Lundell; Mr. Johnson*. Recitations

and written reviews, one or two hours weekly in sections as assigned.—*Professor Whittelsey and Mr. Eccles.*

3B.—*Qualitative Analysis* (Unknown Substances).—The analysis of mixed substances, the composition of which is unknown to the student, and the detection of impurities in pharmaceutical and commercial chemicals.

Twenty-seven laboratory periods of three hours each through nine weeks.—*Professor Whittelsey and Mr. Lundell; Mr. Johnson.*

4.—*Quantitative Analysis, Chiefly Volumetric.*—An introduction to the methods and underlying principles of quantitative analytical work through the study of typical methods. Due attention is paid to the use of the standard "volumetric test-solutions" of the pharmacopœia.

Twenty-seven laboratory periods of three hours each through nine weeks, with lectures and written exercises one hour a week.—*Professor Whittelsey and Mr. Lundell; Mr. Johnson.*

5.—*Quantitative Analysis, Chiefly Gravimetric.*—This course of laboratory practice in gravimetric methods of analysis includes twenty-seven laboratory periods of three hours each.—*Professor Whittelsey and Mr. Lundell.*

6.—*Urine Analysis, Qualitative and Quantitative.*—The detection and determination of constituents of urine which are of importance in the diagnosis of disease.

Twenty-seven laboratory periods of three hours each.—*Elective.*—*Professor Whittelsey and Mr. Lundell.*

7.—*Advanced Quantitative Analysis.*—An extension of courses 4 and 5, leading to the analysis of materials of technical and industrial importance. Iron ores, iron and steel, slags, cements and cement materials, alloys, and the wet assay of ores of copper, lead, zinc, etc.

Fifty-four laboratory periods of three hours each, extending through eighteen weeks.—*Professor Whittelsey and Mr. Lundell.*

For further courses in Analytical Chemistry see Mineralogy and Organic Chemistry courses 5, 6 and 7.

MINERALOGY AND BLOWPIPE ANALYSIS.—Mineralogy, elements of crystallography, descriptive mineralogy, including physical properties, chemical composition, occurrence and association of minerals; determination of minerals by physical characteristics. Blowpipe analysis.

Lectures and laboratory work, six hours weekly through eighteen weeks.—*Professor Crook.*

MINERAL ASSAYING.—Fire assay for base metals, and scorification, cupellation, parting and weighing of gold and silver. Crucible processes for assay of precious metals and general methods for copper, lead and zinc.

Lectures and laboratory work, seven hours weekly through eighteen weeks.—*Professor Crook.*

ORGANIC CHEMISTRY.

1.—*General and Pharmaceutical Organic Chemistry.*—A course of lectures and recitations on the general principles of organic chem-

istry with the study of the most important carbon compounds and their classification. Particular attention is given to substances employed in medicine and pharmacy, such as the important alcohols, ethers, aldehydes, acids, chloroform, chloral, certain compounds of the aromatic series, the so-called "synthetics" of the newer materia medica, etc.

About ninety lectures and recitations, extending through eighteen weeks.—*Professor Gordin.*

3.—*Organic Chemical Operations.*—Laboratory instruction in organic chemistry, including the processes of testing organic compounds for the detection of impurities and adulterations; practical study of methods of taking melting points and boiling points; identification and examination of modern organic compounds such as the so-called synthetics; quantitative estimations of certain organic substances such as formic aldehyde, etc. The production of a variety of ethers and other organic compounds, including several of the newer remedies such as acetanilide, etc.

Twenty-seven laboratory periods of three hours each.—*Professor Gordin.*

4.—*Special Course on Alkaloids, Glucosides, etc.*—A course of about eighteen lectures upon the alkaloids, glucosides and other definite chemical compounds contained in drugs and other plant substances. Their composition, separation, identification, properties and relationships.—*Professor Gordin.*

5.—*Food and Sanitary Analysis.*—The examination of water to determine its potableness and fitness for household uses, and the examination of milk, butter, cheese, beverages and food products generally, and such other work as is usually required of public analysts for sanitary purposes.

Twelve hours laboratory work weekly through eighteen weeks.—*Assistant Professor Patterson.*

6.—*Drug Assaying.*—Practice in the separation, identification and estimation of alkaloids. Valuation of drugs and preparations and related products.

Fifty-four laboratory periods of three hours each.—*Assistant Professor Patterson.*

BOTANY, MICROSCOPY AND PHARMACOGNOSY.

1.—*General Botany*, including Organography and Taxonomy.—A course of lectures and recitations designed to give the student a good general conception of the great plant groups, to present the facts most essential to an intelligent study of vegetable drugs, to elaborate and recapitulate the lessons of the work in the microscopical laboratory, and to impart a knowledge of the classification of plants and the rules of nomenclature.

About two hours weekly through eighteen weeks.—*Professor Pond.*

2A.—*The Microscope and How to Use It.*—A study of the optical properties of mirrors and lenses especially applied to the mechanism and manipulation of the compound microscope. Actual practice in manipulation is given, including methods of determining magnification.

The very best imported instruments with 1-inch and $\frac{1}{4}$ -inch objectives, two eye-pieces, double nose-piece, coarse and fine adjustment, and all other important accessories are furnished to all students.

This course is a necessary preparation for courses 2B and 3.

2B.—*The Microscopic Structure of Plants*.—A laboratory course especially designed to prepare the student for the examination of drugs and other vegetable raw materials with reference to the determination of their identity and quality, and for the detection of adulterations in powdered substances. Particular emphasis is placed upon the anatomy of roots, stems and leaves. A special study is made of starch granules, aleurone and crystals. Each student is assigned a microscope for his own individual use and is furnished with an especially prepared laboratory guide. Cutting sections, preparation of mounts and use of micro-reagents are daily practiced.

Five hours laboratory work weekly through eighteen weeks, including course 2A.—*Professor Pond and Mr. Jensen*.

3.—*Pharmacognosy*.—A study of medicinally and industrially important plant substances. About two hundred of the most important drugs, spices and other raw materials of vegetable origin are thoroughly studied. A study is made of the outer and in many cases of the inner structure. Notes are made of the characteristic features, and spurious articles and adulterants also examined. Special effort is made to develop a capacity to intelligently interpret and apply the pharmacopœial descriptions for the identification of drugs and to form a correct judgment of their quality. Demonstrations are made from specimens of drugs and other substances likely to be confused with each other, but which may be distinguished by their respective structural differences.

The laboratory is abundantly supplied with materials, both dry and alcoholic, permanent mounts and choice museum specimens.

Five hours laboratory work weekly through eighteen weeks, with lectures and recitations one hour weekly.—*Professor Pond and Mr. Jensen*.

4.—*Commercial Microscopy*.—A course designed to afford the requisite training for the duties of the Pharmaceutical Chemist and Public Microscopist, including the examination of powdered drugs, spices, foodstuffs, etc. Specially prepared cross and longitudinal sections of whole specimens are supplied for comparison with the tissue elements as found in powders. A thorough study of the various kinds of starch is made. Hairs and textile fibers are studied. Training is given in microtechnique, including micrometry and work with the camera lucida and polariscope. Special methods for the isolation and determination of the structural elements of woods, stems, leaves, barks, roots, rhizomes, seeds, fruits, glands and spores.

The laboratory is amply supplied with appropriate reagents.

Six hours weekly through eighteen weeks.—*Professor Pond and Mr. Jensen*.

MANUFACTURING.

1.—*Weights, Measures and Chemical Arithmetic*.—Principles of metrology. The metric system. The customary weights and measures of America and Great Britain. Weighing and measuring. Balances

and weights. Specific weight and specific volume. Instruments employed in determining mass and volume and their relations. Working formulas expressed in fixed quantities and in "parts by weight."

Actual practice in pharmaceutical problems connected with the metric system; the relations of weight and volume; percentage strength; problems in diluting and strengthening alcohol, solutions and preparations, and other calculations commonly occurring in pharmaceutical work and in manufacturing.

Lectures, text-book work and class exercises, two hours weekly through eighteen weeks.—*Mr. Eccles.*

2.—*Materials.*—Preparatory study of the materials used in the manufacture of pharmaceutical, chemical and industrial products.

This course is designed to impart to the student a sufficient degree of practical familiarity with the general character and properties of important classes of raw materials out of which he must later make finished preparations. Both inorganic and organic raw materials are discussed to the extent to which this may be profitably done in advance of the study of their chemistry to which this practical introduction to their physical properties is a most helpful preliminary.

The general physical properties and behavior of the most important classes of constituents of plants, such as cellulose, starch, pectin, mucilage, sugars, albumin, fixed oils, volatile oils, resins, tannin, amara, glucosides and alkaloids are reviewed sufficiently to render the practical study of their extraction or elimination, and the manufacture of preparation of plant substances, intelligent and effective.

About eighteen lectures and recitations. Laboratory work supplementing the lessons taught in these lectures is included in course 6.—*Professor Oldberg.*

3.—*Manipulations.*—A preparatory course of lectures and recitations on laboratory operations employed in making and purifying pharmaceutical, chemical and other industrial products. The course covers such processes as those of powdering, solution, filtration, evaporation, crystallization, distillation, precipitation, methods of extraction, including percolation, etc.

Two hours weekly. Laboratory practice is given in course 6.—*Mr. Eccles.*

4.—*Products.*—General review of pharmaceutical and other similar preparations. In this course the products studied are taken up in classes according to their general character and modes of preparation. Powders, triturations, masses, troches, tablets, pills, capsules. Cataplasms, ointments, cerates, plasters, suppositories, bougies. Solutions, waters, mucilage, syrups, glycerites, emulsions. Infusions, decoctions. Tinctures, wines, fluid extracts and other liquid extracts. Solid extracts, oleresins, precipitated resins, etc.

Lectures and recitations two hours weekly through eighteen weeks.—*Professor Oldberg.*

5.—*Applied Inorganic Pharmaceutical and Manufacturing Chemistry.*—The principles specially governing the processes by which inorganic chemical products are made. The selection of materials and methods. Since the chemical products which are pharmaceutically

important embrace not only the chemicals which are used in medicine alone but almost all the products which are industrially important this course covers practically all kinds of inorganic chemical preparations.

Lectures and recitations, two hours weekly through eighteen weeks. Supplemented by courses 6 and 7.—*Professor Oldberg.*

6.—*Preparatory Laboratory Course in the Study of the Materials and Operations of Manufacturing.*—Experimental work on the physical properties and behavior of the raw materials and constituents referred to in course 2. The separation of the constituents from the crude plant substances and from each other, and the manufacture of certain products in the preparation of which the general character of the materials may be most effectively studied.

The manipulations discussed in course 3 are exemplified by actual practice, and the work selected is such as will best familiarize the student with the apparatus employed, the most common materials operated upon, the methods and manipulations, and the simpler preparations. Thus a part of the work consists of examples of the purification of commercial chemicals by recrystallization and by other means. The inorganic substances operated upon include the most common metals, the common acids and alkalies, oxides, salts and other compounds, with which the student thus acquires a sufficiently extensive and living practical familiarity to greatly facilitate his grasp of the science of chemistry.

This course consists of fifty-four laboratory periods of three hours each through eighteen weeks.—*Assistant Professor Miner and Mr. Fischnar.*

7.—*Laboratory Practice in the Manufacture of Inorganic Chemical Preparations.*—A great variety of inorganic chemicals are manufactured by the students, including typical examples of nearly all classes of compounds. Particular attention is given to pharmaceutical and industrial chemicals of special importance or interest or affording especially instructive practice. Among the raw materials employed in the Manufacturing Laboratory are many minerals and other crude natural products in order that students may have practical experience in making finished chemical preparations out of the cheapest and most common materials that can be successfully used. Other and purer materials are, of course, also employed whenever requisite.

Fifty-four laboratory periods of three hours each, extending through eighteen weeks.—*Assistant Professor Miner and Mr. Fischnar.*

8.—*Pharmacy of the Organic Drugs.*—The important manufactured preparations of individual plant drugs. The relation of the constituents of the drugs to the methods employed in the preparation of their extracts, liquid and solid, and other important products. A thorough discussion of the scientific principles governing the pharmacy of organic drugs and the preservation of their preparations.

Lectures and recitations two hours weekly through eighteen weeks.—*Professor Oldberg.*

13.—*Laboratory Practice in the Production of Miscellaneous Organic and Inorganic Pharmaceutical and Industrial Products.*—Advanced work in the Manufacturing Laboratory.

About thirty-four laboratory periods of three hours each, extending through eighteen weeks.—*Professor Miner and Mr. Fischnar.*

The following additional courses are given in the School of Pharmacy in the program of work leading to the Degree of Pharmaceutical Chemist. Students successfully pursuing these courses in addition to those outlined above for the training of analytical chemists and microscopists will be granted that degree. The combined program of work may be completed in five terms.

INORGANIC AND ANALYTICAL CHEMISTRY, 6.—*Urine Analysis*, qualitative and quantitative. The detection and determination of constituents of urine which are of importance in the diagnosis of disease.

Twenty-seven laboratory periods of three hours each.—*Professor Whittelsey and Mr. Lundell.*

ORGANIC CHEMISTRY, COURSE 7.—*More Advanced Work in Organic Analysis*.—Water Analysis. The examination of oils, fats, waxes, soaps and other industrial materials and products.

Three laboratory periods of three hours each through one semester of eighteen weeks.—*Assistant Professor Patterson.*

BACTERIOLOGY.—Lectures one hour weekly and laboratory work nine hours weekly through nine weeks. The most approved methods are taught.

Bacteria in health and disease. Culture Media. Culture Methods. Staining. Identification of some of the more common bacteria of earth, air and water. Toxins and antitoxins.

Non-pathogenic germs are first used for purposes of instruction. The common disease producing bacteria are then studied.

The course is a practical one, enabling the student to fit himself to do successfully the bacteriological work ordinarily required for medical diagnosis and for sanitary purposes.—*Professor Pond and Mr. Jensen.*

MANUFACTURING, 9.—*Miscellaneous Preparations and Products*.—Unofficial pharmaceutical, medicinal, surgical, sanitary, dietetic and other articles usually supplied by pharmacists, including surgical dressings, antiseptics, toilet preparations, perfumery, flavoring extracts, etc.

About twelve lectures.—*Professor Oldberg.*

PHARMACY, 10.—*The Pharmacopoeia of the United States and Pharmacopoeias of Other Countries*.—Lectures and recitations on the character, scope and functions of pharmacopœias. A systematic study of the essential distinctive features of the text of the American Pharmacopœia.

How it is constructed.

The principles of construction of systematic pharmaceutical nomenclature and its relations to proper classification of the medicinal substances. The bearings of the nomenclature upon scientific pharmacy. Latinic and non-latinic titles. Non-systematic names. The latinity of the American pharmacopœial nomenclature.

Every American student of pharmacy should own and study the Pharmacopœia of the United States, and in the School of Pharmacy of Northwestern University that law-book for the pharmacist is studied in the class room, book in hand. Each student is expected to have the text before him at every recitation.

Comparative study of the pharmacopœias of the world, their scope, their style of construction, materia medica, chemistry, pharmacy, nomenclature, preparations, and other important features.

A course of about twelve lectures.—*Professor Oldberg.*

PHARMACY, 11.—*The Professional-Technical Duties and Responsibilities of Pharmacists*, including the relations of pharmacists to the medical profession and the community.

The Prescription; its construction and interpretation. The prescription table and its problems. Dispensing.

The demands of modern scientific medicine upon the pharmacist of this country.

Pharmacy laws, poison laws, etc.

A course of about twelve lectures.—*Professor Oldberg.*

PHARMACY, 12.—*Laboratory Course in Dispensing*.—It is now generally conceded that a systematic course of laboratory training in the art of making extemporaneous pharmaceutical preparations and in compounding and dispensing medicines must be a fundamental and crowning feature of any first-class school of Pharmacy. In the Dispensing Laboratory of the School of Pharmacy of Northwestern University (the first workshop of its kind) the student sees and learns to use an outfit of dispensing apparatus many times as extensive as can be found in many of the best drug stores together. Every student is required to make a great variety of extemporaneous preparations. The lessons are systematically prepared or selected with the view to include all important phases of work at the dispensing table with all kinds of materials and by all the different methods practiced. A practical experimental study of incompatibilities is included in this course.

Two laboratory periods of two hours each, weekly, through eighteen weeks.—*Mr. Eccles.*

HUMAN ANATOMY AND PHYSIOLOGY.—This course is intended to sufficiently acquaint the student with the morphology and physiology of the human body to enable him to understand the processes of digestion, assimilation, circulation, respiration and nerve action, and the physiological action of drugs.

A course of eighteen lectures and recitations.—*Assistant Professor Kahn.*

MATERIA MEDICA AND THERAPEUTICS.—About thirty-six lectures and recitations on the properties, action, uses and doses of drugs and their preparations, together with a discussion of poisons and their toxic effects and antidotes.—*Assistant Professor Kahn.*

PROGRAMME OF WORK.

		—Hours per week.—	
		Lectures.	Laboratory.
<i>First Term.</i>			
INORGANIC AND ANALYTICAL CHEMISTRY.			
1.	Inorganic Chemistry	5	
2.	Inorganic Chemistry		
		(2)	9
3A.	Qualitative Analysis		
BOTANY AND MICROSCOPY.			
1.	General Botany	2	
2A.	The Microscope and Its Use.....		
			5
2B.	Microscopic Structure of Plants.....		
MANUFACTURING.			
2.	Materials	1	
3.	Manipulations	1	
6.	Materials and Operations of Manufacturing		9
<i>Second Term.</i>			
ANALYTICAL CHEMISTRY.			
3B.	Qualitative Analysis (continued).....		
		1 or 2	9
4.	Quantitative Analysis, Volumetric.....		
MICROSCOPY AND PHARMACOGNOSY.			
3.	Pharmacognosy	1	5
MANUFACTURING.			
1.	Weights, Measures and Chemical Arithmetic	2	
7.	Manufacture of Inorganic Chemical Preparations		9
<i>Third Term.</i>			
ANALYTICAL CHEMISTRY.			
5.	Quantitative Analysis, Gravimetric.....		9
ORGANIC CHEMISTRY.			
3.	Organic Chemical Operations.....		
1.	General Organic Chemistry.....	5	
6.	Drug Assaying		9
MINERALOGY AND ORE ASSAYING.			
1.	Mineralogy	2	4
MICROSCOPY AND PHARMACOGNOSY.			
4.	Commercial Microscopy		6
MANUFACTURING.			
8.	Organic Drugs	2	
<i>Fourth Term.</i>			
CHEMISTRY.			
7.	Quantitative Analysis, Advanced.....		9
ORGANIC CHEMISTRY.			
4.	Alkaloids, Glucosides, etc.....	1	
5.	Food and Sanitary Analysis.....	1	12
MINERALOGY AND ORE ASSAYING.			
2.	Ore Assaying	1	6
MANUFACTURING.			
5.	Applied Inorganic Pharmaceutical and Manufacturing Chemistry	2	

DATES OF ADMISSION.

The laboratories of Northwestern University in which these courses are given are open nearly eleven months in each year. That time is divided into two terms of eighteen weeks each and one term of seven weeks.

The *Fall Term* begins in the second week of September and ends at the beginning of February.

The *Spring Term* begins in the first week of February and ends about the middle of June.

Students may enter at the beginning of either the Fall Term or the Spring Term.

FOUR TERMS OF EIGHTEEN WEEKS EACH ARE REQUIRED FOR THE COMPLETION OF THE COURSE OF TRAINING OFFERED TO students desiring to prepare themselves for the occupation of general and analytical CHEMISTS AND MICROSCOPISTS.

THE SUMMER SCHOOL.

The *Summer Term* begins on the Monday immediately preceding the Annual Commencement of the University on the third Thursday of June.

The courses given in the Summer Term are arranged for the convenience and benefit of students who wish to take additional work, or to review or repeat one or two individual courses, or to distribute their work over an additional period in order to be enabled thereby to hold positions whereby they may earn part of their expenses, and for special students, graduates and non-graduates, who desire to take some one or two of the special courses offered.

The laboratory courses given in the Summer Term are such as can be satisfactorily completed in seven weeks with twelve or twenty-four hours' work weekly. Two or three such courses can accordingly be carried together.

Among the courses which may be taken in the summer school are those in: *Pharmaceutical Preparations*, from 12 to 24 hours weekly; *Dispensing*, 12 hours weekly; *Qualitative Analysis*, 12 or 24 hours weekly; *Quantitative Analysis*, 12 or 24 hours weekly; *Urine Analysis*, 12 hours weekly; *Plant Histology*, 12 hours weekly; *Pharmacognosy*, 12 hours weekly; *Drug Assaying*, 12 to 24 hours weekly; *Commercial Microscopy*, 15 hours weekly; *Food Analysis*, 15 to 24 hours weekly; and *Bacteriology*, 12 hours weekly.

Pharmacists, physicians, chemists, teachers and others may avail themselves of these summer courses.

ADMISSION REQUIREMENTS.

For admission to these courses for the training of analytical chemists and microscopists students must possess a general education equivalent to that required for graduation from a high school of the best grade.

GENERAL REQUIREMENTS.

The conditions of promotion and the granting of certificates include: Satisfactory deportment, due observance of the rules, regular attendance during the full period prescribed, satisfactory completion of the required work, good standing in the recitations and examinations throughout the courses, diligence and success in the laboratory work, payment in full of all dues, and the settlement of all accounts.

CREDITS.

Any student presenting proper evidence of having satisfactorily completed in any approved school any one or more of the courses of study or laboratory work included in the programme of study may, if desired, receive such credit therefor as may be consistent with the prescribed requirements.

EXPENSES AND DEPOSITS.

The *matriculation fee*, payable only once and before registration, is \$5. It is not returnable.

The *tuition fee* for the special program of instruction and laboratory work arranged for the training of *chemists and microscopists* is \$65.00 for each term of eighteen weeks. This sum covers the cost of regents and other chemicals used in the laboratory work.

The tuition fee for individual laboratory courses, taken separately, whether taken in the summer terms or at other times, is about \$10 for each course of about eighty to eighty-four hours, or \$20 for a course of twice that amount of work. This fee includes drugs, chemicals and other laboratory materials consumed.

Students taking partial, divided or special courses are required to pay tuition fees corresponding to the amount of work taken by them.

A charge is made of two dollars per term for the use of microscopes, balances and other apparatus, and for their maintenance and replacement.

To cover the cost of apparatus lost, destroyed or damaged, and any damage willfully or needlessly inflicted to building, furniture or other property, each student is required to make a deposit of \$5 before being assigned tables in the laboratories. This deposit is intended to cover the whole term and is in most cases sufficient for that purpose. But students who may damage or destroy apparatus or other university property to the value of more than the amount of their deposits will be required to make good the damage in addition. Deductions will be made from the deposit to cover the cost of avoidable loss or breakage and articles not returned.

Each student is charged for any damage or loss for which he is individually responsible and for his *pro rata* share of damage or loss the responsibility for which can not be individually located. The remainder of his deposit is returned to each student at the end of the term or whenever he discontinues his attendance.

Certain indispensable articles (not materials consumed) are necessarily furnished for the convenience of students and to render the work effective and orderly. These articles include, for example, note-books, drawing-books, dissecting needles for use in the microscopical laboratory, aprons and sleeves, additional pieces of apparatus required to replace those broken or lost, etc. For this purpose each student is required to obtain a coupon ticket to the amount of \$5. Supplies of this kind are issued in no other way. Unused coupons are redeemed at the end of the year or whenever the student discontinues his attendance.

The fee for the certificate payable not later than two weeks before the same, is \$10.

Individual lockers are rented to students at \$1 each. That rental covers the whole period of the student's uninterrupted attendance, whether that be one or two terms.

SEPARATE COURSES IN ANY DEPARTMENT.

Any student may take any one or more of the separate courses given in Pharmacy, Botany, Inorganic Chemistry, Qualitative Analysis, Quantitative Analysis, Organic Analysis, Pharmacography, Dispensing, Urine Analysis, Bacteriology, or other subjects, at his option, and will receive full credit for all such work when satisfactorily done. This applies both to the didactic courses and to the laboratory work.

But no student will be received for a less period than one term.

WOMEN.

Women being admitted to the classes, there is provided a separate study and dressing room for their exclusive use.

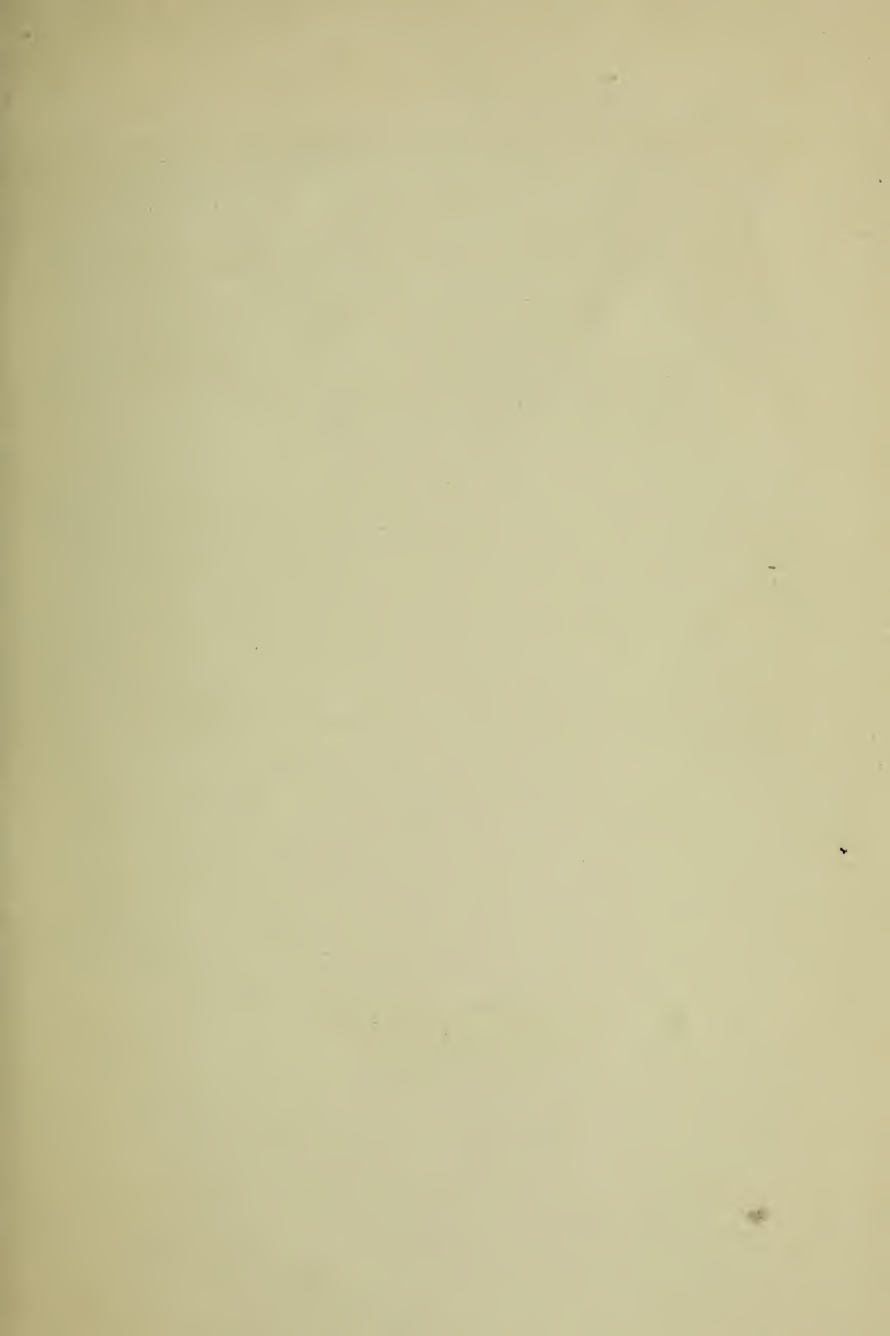
EARLY ENROLLMENT.

All the students intending to enter upon this course of study will find it a great advantage to write early for information and matriculate in good season.

BOARD AND ROOM.

Very good board and room together can be secured near Northwestern University Building at from \$4 to \$6 per week. Students may also secure rooms and board separately. Information in regard to these matters and addresses of reliable and satisfactory private boarding places and furnished rooms will be supplied. Good accommodations are plentiful, and satisfactory arrangements can be quickly made by each student immediately upon his arrival. It is wholly unnecessary and rarely advantageous to secure board and room in advance.







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